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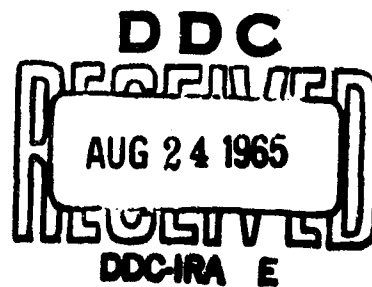
PRINCIPAL PROBLEMS OF EPIDEMIOLOGICAL GEOGRAPHY
II. THE NOTION OF NOSOLOGICAL AREAS

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PRINCIPAL PROBLEMS OF EPIDEMIOLOGICAL GEOGRAPHY
II. THE NOTION OF NOSOLOGICAL AREAS

[Following is the translation of an article by I. I. Yelkin and V. K. Yashkul, Moscow Medical Institute of the order of Lenin imeni Sechenova, appearing in the Russian-language periodical Zhurnal Mikrobiologii Epidemiologii i Immunobiologii (Journal of Microbiology, Epidemiology and Immunobiology), #11, 1964, pages 48-54. The article was submitted to the editors on 4 January 1964. Translation performed by Sp/4 Richard M. Koplen]

The distribution of infectious and parasitic diseases on the globe is dependent on a complex of objective causes and has a natural character. On the whole, the geographical distribution of infections and infestations is explained by the nature of the causative agent, living conditions, and historical reasons. Therefore, the regularities of distribution of these diseases are diverse. Their study calls for a comprehensive analysis of a great many factors of a biological and social order.

When the investigator proceeds to the study of the geography of infectious and parasitic diseases of man, he primarily pays attention to the territory where the given illness is registered among people. Obviously, the origin of this disease in the given territory may be diverse. The specific disease may be endemic for the given territory or have an exotic origin or be connected with the source of infection among people or among animals. A sick man may prove to be, epidemiologically or epizootologically, a significant source of infection or be "a blind alley" for the causative agent. On account of this, territories, in the limits of which the morbidity of people with this or that nosological form is registered, turn out to be diverse in an epidemiological respect. And what's more, with the contemporary level of means of communication, man, who was somewhere infected by the given disease, can migrate during the incubation period to practically any point of the globe and can be registered in those territories to which the given nosological form is not natural. Thus, it is impossible to assume that every territory in which the morbidity of people with a specific nosological form is registered, is a basis for the nosogeographical structure.

Evidently, in order to have a real possibility to study the geographical distribution of infectious and parasitic diseases of man and to find out its causes, it is necessary primarily to isolate the main

territorial unit of disease distribution, which must have strict geographical significance. The areal of a disease (E. N. Pavlovskyy, 1944, 1954, 1956; Mey, 1954; Beklemishev, 1959, and others) or nosoareal (Shoshin, 1961, 1962) should be considered as such units in epidemiological geography.

Various factors, which determine the geographical distribution of infectious and parasitic diseases of man, signify that the nature of nosological areas in various groups of diseases proves to be diverse. Because of this, we can only give the determination of the nosological area of diseases in a most general outline. The aggregate of territories of the globe, in the limits of which the given nosological form is endemic, should be considered the nosoareal of infectious and parasitic diseases of man. In this definition of nosoareal a more precise understanding of "endemic diseases" is required.

In biogeography the majority of investigators define the concept "endemism" (endemics, endemic forms) as the confinement of individual species (forms) to a limited area or even to a specific point. This same concept of endemic forms in biogeography is opposed to the concept on the universal (or at least wide) distribution of given groups of organisms (Voronov, 1963).

Initially, approximately in this sense the concept "endemism" was used also in epidemiology. Thus, D. K. Zabolotnyy (1899, 1926, 1929) spoke about the endemic nature of cholera and plague, but refrained from using this term for universally distributed diseases. Weichselbaum (1900) also called diseases, the distribution of which "was limited by known facilities", endemic.

However, already in the first quarter of the 20th century new concepts of the endemic nature of diseases appeared. Mueller (1917) called endemic certain "contagious diseases", which "take root in the same place and do not disappear, but remain for years, decades, centuries, being manifested with more or less strength (leprosy, tuberculosis)" (page 145). These concepts are reflected also in modern literature. Thus, V. M. Zhdanov (1961) considers as most correct (?) under the term "endemia" to understand "diseases peculiar to a given country, locality" (page 62), as opposed to the concept of exotic diseases. These concepts permit reference to endemic as diseases having both limited distribution and universally distributed nosological forms.

A significant clearing up in concepts concerning endemism of diseases of man which related to this group such diseases, the source of origin of which was found within the given country or locality (Gromashevskyy, 1949, page 125), was introduced by L. V. Gromashevskyy (1941, 1949). These concepts concerning endemism of diseases received wide distribution in contemporary, epidemiological literature.

Thus, at the present time, the supposition concerning endemic diseases of man opposes the concept "exotic diseases", which makes it possible to regard any infection or infestation which takes root within its limits regardless of the actual distribution, as endemic for this or that locality.

Together with this, the definition of endemicity of diseases presented by L. V. Gromashevskyy has a too generalized form and requires a concrete definition. In this definition only the fact itself of the presence of the source of infection within the given locality is indicated, but nothing is said about the causes of the appearance of the source of the infection. The constant presence of the source of infection within the limits of a specific territory, originating in connection with the constant bringing in of it from outside, of course can not characterize the territory as endemic with respect to the given disease. For example, in certain cities where gnats of the genus *Phlebotomus* exist, it is possible to observe a constant import of the causative agent from natural foci of cutaneous leishmaniasis of the rural type along with sick people. As a result, during the presence of the source of infection in these cities in the summer, periodic foci of cutaneous leishmaniasis with the causative agent *Leishmania tropica* major will arise. However, it is not possible to consider the territories of these cities as endemic for cutaneous leishmaniasis of the rural type. The discontinuance of the migration of sick people from the natural foci leads to the spontaneous disappearance of the disease in such cities (the relatively short incubation period and the comparatively rapid flow of the disease result in the fact that in the course of the winter period, when gnats are inactive, all the infected people recovered).

Thus, such infectious and parasitic diseases of man, the causative agents of which are continuously reproduced within the limits of a territory and where infection of people is found, should be called endemic for the given territory.

After examining each definite specie of causative agent of an infectious or parasitic disease of man as a completely definite biological system, we must primarily, during a study of the geography of disease, set apart the territory within the limits of which the continuous existence of the causative agent on definite carriers is supported. These territories are the areal of a species of causative agent.

It should be stressed that "areal of a species of causative agent" is a biogeographical concept in comparison to "nosoareal", which is an epidemiological and geographical concept. Because of this, suppositions

concerning endemism of a species of causative agents must be based on a biogeographical concept concerning endemicity. These suppositions are not identical to the concept concerning endemism of diseases. Thus, in speaking about the endemicity of plague or tularemia in territories of natural foci of these infections, we mean the presence of human morbidity with these diseases in these or those regions, which are distributed in territories of natural foci. At the same time, Pasteurella pestis and F. tularensis have a sharply expressed zonal distribution and thus the corresponding infections are not endemic.

As the areal of a species of a causative agent, it is not necessary to consider all the territories of the world in which the causative agent was detected at some time or other, but only those sectors of land within the limits of which the continuous reproduction of the causative agent takes place. All the other territories in which the given causative agent is encountered are sectors where the infection (infestation) is endured.

Each areal of the causative agent has a complex and mobile, spatial breakdown. Within the limits of the areal, the causative agent is not distributed everywhere and, as a result, a more or less complex picture is formed (a lace of the areal) which represents, essentially, the whole complex of "foci of causative agents of diseases" interacting between each other. Each of these foci is more or less detached from other foci of the territory, within the limits of which occurs the continuous reproduction of the causative agent on its principal carriers.

Evidently, the structure of such foci of causative agents of diseases is found in direct relation to the structure of the parasitic system of the given nosological form and primarily -- on the basic carriers of the causative agent. The basic carriers of causative agents of infectious and parasitic diseases of man may be man, animals, and also man and animals. In accordance with this, we are able to classify all infectious and parasitic diseases of man into anthroponoses, zoonoses, and anthroponozoonoses. Each of these groups of diseases has its own peculiarities of formation of the areas of causative agent species, due to which they essentially differ in the regularities of formation of nosoareals.

A group of diseases, the causative agents of which are true parasites of man, should be called anthroponoses. The existence of such parasitic forms is provided for owing to the continual reproduction of the causative agent in human associations. Animals do not take part in supporting the existence of the causative agent, although in individual cases they can be infected by man (for example, with epidemic influenza, smallpox, pediculous typhus, etc.).

Foci of causative agents of anthroponoses within the limits of which a continuous reproduction of the causative agent occurs, and from the aggregate of which the nosoareal of anthroponoses is formed, are

endemic foci. The term endemic foci includes such associations of people who are populating definite geographical territories, among which, under certain living conditions and owing to the continuously flowing epidemic process, the existence of the causative agent is supported for an indefinitely long period of time. The territories of these foci are endemic relative to the given anthroponosis.

Thus, the areal of the causative agent of a definite anthroponosis coincides with its nosoareal, which is an aggregate of endemic foci.

Zoonoses are nosological forms, the causative agents of which, in the process of phylogenesis, adapt completely to definite species of animals (mainly mammals). These animals are the principal carriers of causative agents and the causative agents -- their true parasites. The main carriers assure the continuity of existence of the causative agents of zoonoses.

Besides the main carriers, the causative agents of zoonoses can also affect other species of animals -- secondary and accidental carriers which do not take a direct part in the reproduction of the causative agent.

The continuous reproduction of causative agents of zoonoses is carried out in enzootic foci which represent definite groups of animals (main carriers), populating definite geographical territories and among which the continuous reproduction of the causative agent is carried out.

The principal carriers of the causative agents of zoonoses can belong to various groups of animals (farm, wild or synanthropic animals). Therefore, zoonoses can be subdivided into zoonoses of farm animals (foot and mouth disease, glanders, etc.), naturally focal zoonoses (plague, tularemia, etc.) and zoonoses of synanthropic animals (rat rickettsiosis, rat bite fever, etc.). Zoonoses also have principal carriers which are simultaneously farm and wild animals (anthrax), synanthropic and wild animals (pseudotuberculosis) or all three groups of animals (trichinosis, echinococcosis).

In accordance with this, enzootic foci can be classified into enzootic foci among farm animals (man made enzootic foci), enzootic foci among wild animals (natural foci) and enzootic foci among synanthropic animals (synanthropic enzootic foci). Evidently, in some case, when the principal carriers of zoonoses are two or three groups of animals, enzootic foci of various categories are formed which interact with each other.

Man made enzootic foci are individual animal raising industries and their complexes, in the territories of which under the conditions of concrete up-keep of livestock the continuous reproduction of the causative agent takes place due to the continuously flowing epizootic process.

Natural foci are sectors of territories of a definite geographical landscape, within the limits of which the reproduction of causative agents has been going on continuously for a long period [definition of natural focus given by E. N. Pavlovskyy (1939, 1960, etc.) and V. N. Beklemishev (1959, 1961, etc.)].

Somewhat apart from zoonoses of farm animals and zoonoses with a natural focalness stands zoonoses of synanthropic animals. Synanthropic enzootic foci have a number of significant differences both from man-made enzootic and from natural foci. They are the functionally connected with each other populations of principal carriers (synanthropic, warm-blooded) and carriers, among whom continuous reproduction of the causative agent of the given zoonoses takes place.

The formation of synanthropic enzootic foci occurs under the powerful influence of man's practical activities, and brings them together with man-made enzootic foci, and at the same time synanthropic animals maintain a population structure characteristic also of wild animals.

During zoonoses, the principal carriers of the causative agents which belong to various groups of animals can form enzootic foci which are diverse in their structure. These foci, for a series of zoonoses, can be more or less autonomous (for example, man-made enzootic foci and natural foci with primary carriers as with deer during brucellosis). However, there are zoonoses during which the circulation of causative agents is most intimately connected with various groups of animals (anthrax, rabies, trichinosis). In these cases more or less independent enzootic foci of a definite category cannot be singled out. Under definite conditions the causative agents of zoonoses can infect man, however man is "a dead end" of infection for zoonoses and therefore takes no part in the continuous process of reproduction of the causative agent. Evidently, the morbidity of people with zoonoses is confined to enzootic foci and thus, the distribution of zoonotic disease of man depends primarily on the areal of the causative agent of the given zoonoses. Together with this, the morbidity of people with zoonoses depends completely on the social-economic conditions of the people found in the territory of enzootic foci. Within the limits of the areal of the causative agent of definite zoonoses, human morbidity is encountered only where there are corresponding social-economic conditions favorable to its existence. Therefore, only in some cases does human morbidity arise within the limits of the entire areal of the causative agent of a given zoonoses. As a rule, considerable territory of the natural foci is not thoroughly populated by man. Besides that, at the present time humanity has effective means for combating many zoonoses (sanitary-economic measures, vaccinations, etc.). Putting these measures into practice leads to the liquidation of morbidity with zoonoses in the territory of active enzootic foci.

Thus, territories of enzootic foci within the limits of which, by virtue of definite social-economic conditions, infections of people arise,

should be considered endemic with respect to the given zoonoses. Namely, these territories, which are epidemiologically active sectors of enzootic foci, are the nosoareal of zoonoses.

Anthropozoonoses are infectious and parasitic diseases of man, the causative agents of which in phylogenesis are adapted both to man and to some species of animals, and thus are true parasites of man and these animals. The continuity of existence of causative agents of anthropozoonoses is ensured due to its circulation among people and animals. Such infectious diseases as yellow fever, tick borne recurrent typhus, African and American trypanosomiasis, some forms of leishmaniasis and others should be regarded as anthropozoonoses. In the group of anthropozoonoses it is also necessary to include some infestations: taeniasis, diphyllbothriasis, opisthorchosis, filariasis, and others.

Depending on the character of flow of the epidemic process and its bond with the epizootic process during anthropozoonoses, various foci of causative agents of diseases are formed. Thus, during yellow fever, more or less independent (but found in interaction) natural foci in jungles and endemic foci in cities can be formed. During tick spirochetosis in small villages extremely complex "foci of causative agents of diseases" are formed. Circulation of the causative agent in these foci is accomplished due to principal carriers -- farm animals (mainly hoofed) and synanthropic animals (rats). From time to time, man is included in the circulation of the causative agent. At the same time natural foci exist in wild nature during tick-borne recurrent typhus.

Evidently, anthropozoonoses are endemic in all territories where man is included in the circulation of the causative agent, and also in territories of natural foci, where infection of people occurs. In accordance with this, a nosoareal of anthropozoonoses is formed due to both endemic and also to enzootic foci within the limits of which the morbidity of people is observed.

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